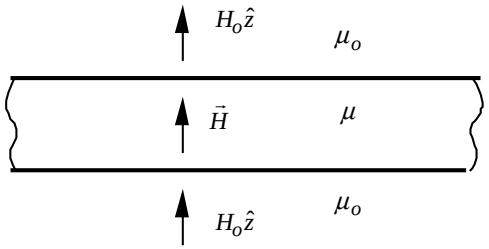
EC2600 Sample Exam Problems

1. The magnetic field intensity at a point in space is given by $\vec{H} = 3\hat{x} + 7\hat{y} + 2x\hat{z}$. Find the current density, $\vec{J}$.

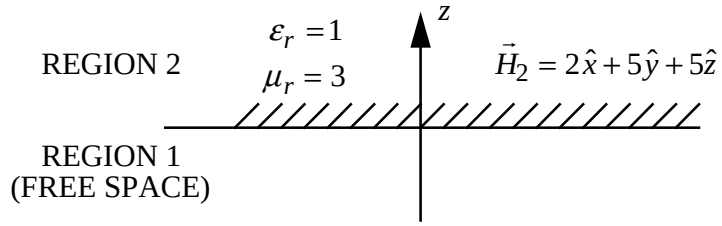
2. Find the magnetic flux density $\vec{B}$ at a distance r from the center of a wire of length $2L$ carrying a current I. Use the Biot-Savart law.

3. A flat panel of material is placed in a constant magnetic field that is perpendicular to the panel faces as shown.
(a) Find $\vec{H}$ inside of the material if it has relative permeability μ.
(b) Find $\vec{H}$ inside of the material if it has a permanent magnetization $\vec{M} = M_o\hat{z}$.



4. A particle of charge q is rotating in a circular orbit of radius r in the $x-y$ plane. The angular velocity is ω rad/sec. What is its magnetic dipole moment?

5. An infinite flat boundary between free space and a medium with $\varepsilon_r = 1$ and $\mu_r = 3$ is located in the $z = 0$ plane. The magnetic field intensity in the material is given by $\vec{H}_2 = 2\hat{x} + 5\hat{y} + 5\hat{z}$. Find $\vec{B}_1$.



6. A ferromagnetic material operates in the linear region of its hysteresis loop (*B*-*H* curve). Its relative permeability is 50 and B = 0.05 T. Find the susceptibility, magnetization and magnetic field intensity ($\chi_m, M,$ and H).

7. A short $\hat{y}$ -directed 150 mA current element is located at $x = 0.02\,\text{m}$, $y = 0\,\text{m}$ and $z = 0\,\text{m}$. If its length is 1 mm, find the contribution of this current element to the magnetic field at the point $P(x, y, z) =$ (0,0.03,0).

8. The potential in a region of space is given by $V(x, y) = 100(x^2 + y^2)$.
(a) What is the electric field in the region?
(b) Given that the point $P(x, y, z) = P(2, -1, 3)$ in this region is situated on a boundary between a conductor and air, what is the potential of the conductor surface?
(c) What is the magnitude of the surface charge density on the conductor?